Moolarben Coal Independent Water Quality Study

Summary

Despite the *Independent Water Quality Study (IWQS)* providing a reasonable first response to the Conditions of Consent for Moolarben Mod14 (Condition 32A) and requirements under EPA licence condition *E1 Independent Water Quality Study*, given the complexity of the issues in the Upper Goulburn River, there remain significant weaknesses in the approach adopted:

1. The IWQS did not consider all Electrical Conductivity (EC) data that exists for UCML site SW01[1];
2. The dataset used for EC calculations did not include any of the earlier data for GS210046[2]. If the earlier GS210046 data are added to the EC data used to generate an 80th percentile EC level in the IWQS, then using the ANZECC approach, the result would be an 80th percentile EC level of **616 µS/cm[3]**;
3. The IWQS did not identify or discuss the discrepancies between Moolarben Coal's and UCML's EC levels measured in the Upper Goulburn River on the same day for sites in close proximity (UCML SW01 and MCO SW12)[4];
4. The IWQS did not identify whether the Goulburn River was flowing (or ponded) at the time of water quality sampling for the data used in the water quality assessment.
5. The IWQS appears to have relied on only one sample (taken 24 June 2021[5]) for toxicity testing. Extrapolating toxicity assessments from one sample to all discharges is considered dangerous given the likely variability in mine effluent on any given day.
6. The IWQS did not discuss in detail exactly how Moolarben Coal manages *WTP Filtrate* and *WTP Permeate* to end up with the *WTP Discharge[6].*
7. Since the LDP1 discharge is currently achieving EC levels of 250 µS/cm to 350 µS/cm for LDP1, there appears to be little need to have a higher EC level than this on the EPL. Having a higher EPL limit could potentially provide an incentive to increase salt load discharges to the Upper Goulburn River even further.
8. The IWQS has taken a very narrow focus on just EC and salinity and has failed to consider the ionic composition of the proposed discharge waters or the cumulative salt load to the Upper Goulburn River. The IWQS provided an inadequate description of the cationic and anionic composition of waters at the sites considered or for the LDP1 discharge.
9. The IWQS lacks any consideration of the cumulative impact of the Moolarben Coal operations, especially given Ulan Colliery already discharges substantial amounts of saline water to the Upper Goulburn River.

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[1] In particular, the publicly available data in UCML's Annual Reports for the last decade.

[2] EPA's letter, included with the IWQS, stated: *The EPA has reviewed the supplementary information contained within your letter and agrees that the proposed use of monitoring data from 'UCML SW01 and other co-located sites (namely **SW12 and GS 210046**)' is appropriate to be used in the IWQS to determine background salinity.*

[3] ~70 µS/cm lower than that calculated in the IWQS.

[4] Or the reasons for such discrepancies.

[5] *Diluent water for control in the ecotoxicity testing was selected for collection from the Goulburn River reference monitoring site UCML SW01 / SW12 (2x25 L: Figure 4) above the mine influence, and WTP Filtrate (1x25 L) as the treatment water at MCO for EC and salinity toxicity evaluation were collected in 5 L acid-rinsed containers on 24 June 2021*. [IWQS p34]

[6] There were also very few details on exactly how the brine stream is managed/disposed of.

10. Due to the issues identified above, the conclusion that "*the current NSW EPA limit for electrical conductivity (EC) of 685 µS/cm is considered acceptable*[7]*, and given the lack of toxicity responses to salinity, a limit that reflects the historical EC limit at the MCC, as well as the current EC limit at Ulan, of 900 µS/cm could also be considered acceptable"* is not supported.

Context

On the 6 April 2018 the NSW EPA requested assistance from OEH SD with a strategy for discharges into the Goulburn River catchment, considering proposed modifications to the Ulan and Moolarben Coal Mines. On the 10 April 2018 the NSW EPA, OEH SD and DPE met with Moolarben Coal representatives to discuss issues raised in relation to the Moolarben Coal Expansion. On 28/05/2018 the NSW EPA wrote to OEH SD requesting a review of the Response to Submissions (RTS) for the Moolarben Coal expansion (Moolarben Coal 2018). OEH SD provided comment of the RTS on the 4th June 2018.

The major issues associated with the MCO expansion were summarised by OEH SD as:

1. The salt load to be discharged to the Upper Goulburn River
2. The proposed flows to the Upper Goulburn River and lack of appropriate monitoring of flows in the area.
3. The quality (including ionic composition) of the proposed discharge waters
4. The lack of an adequate cumulative impact assessment for the Moolarben Coal expansion, especially given Ulan Colliery already discharges substantial amounts of saline water to the Upper Goulburn River.

In July 2019 Moolarben Coal Operations (MCO) received approval (Project Approval 05_0117 and Project Approval 08_0135) for the Open Cut Optimisation Modification (Mod 14). The Modification allowed, amongst other things, installation of water treatment facilities and changes to controlled releases of water from the Moolarben Coal Complex (MCC). In response to the Modification, Project Approval (05_0117) was revised to include the requirement for an Independent Water Quality Study (IWQS) under Condition 32A, as reproduced below:

By 1 December 2021, unless the Secretary agrees otherwise, the Proponent must complete an Independent Water Quality Study in accordance with ANZECC Guidelines, in consultation with EPA and to the satisfaction of the Secretary. The study must:
a) be undertaken by an independent scientific organisation with suitable water expertise whose appointment has been approved by the Secretary;
b) collect and utilise water quality monitoring data in the Goulburn River using locations endorsed by the EPA;
c) determine appropriate background salinity and heavy metal levels for the Goulburn River upstream of the project site;
d) recommend an electrical conductivity limit for treated water discharges to the Goulburn River from the Moolarben Coal Complex based on the process outlined in the ANZECC Guidelines.

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[7] Acceptability in this case is subjective as the IWQS has not considered salt loads or that under current discharges LDP1 adds ~460 tonnes/annum of additional salt to the Upper Goulburn River. This load is then added to by the ~2600 tonnes/annum of salt load being discharged into the Upper Goulburn River by UCML. Considering EC concentration alone without consideration of salt load is not considered 'acceptable'.

The EPA Licence 12932 for Moolarben Coal Mine subsequently stipulated that:

> ***E1 Independent Water Quality Study***
> *E1.1 The licensee must complete an independent water quality study that must:-*
> - *be undertaken in accordance with the ANZECC Guidelines;*
> - *be undertaken by an independent scientific organisation;*
> - *collect and utilise water quality monitoring data in the Goulburn River using locations endorsed by the EPA;*
> - *determine appropriate background salinity and heavy metal levels for the Goulburn River upstream of the premises; and*
> - *recommend an electrical conductivity limit for treated water discharges to the Goulburn River from the premises based on the process outlined in the ANZECC Guidelines.*

A report summarising the findings from this study was required to be provided to the Central West (Bathurst) Office of the EPA within the time frame stipulated under condition 32A of Stage 1 Mod 14 (project 05_0117).

The EPA had previously reviewed the supplementary information contained within a letter from Moolarben Coal and agreed that the proposed use of monitoring data from 'UCML SW01 and other co-located sites (namely SW12 and GS 210046)' was appropriate to be used in the Independent Water Quality Study (IWQS) to determine background salinity and heavy metals levels in the Goulburn River upstream of the Moolarben Coal Complex.

Additionally, the EPA provided the following comment and recommendation which should be provided to the University of Queensland to assist with the IWQS:

> 1. When determining background levels for conductivity (and possibly a range of other analytes) that it is important to understand whether the Goulburn River was flowing at the time of water quality sampling (at SW01) and to treat with caution any data that may be associated with zero flow (i.e. the potential for the sample to represent ponded/stagnant water).
>
> 2. Testing local aquatic species in any toxicity testing undertaken as part of the IWQS (e.g. *Austrophlebioides pusillus* as described by Dowse et al 2017).

The EPA subsequently received a report from Moolarben authored by Professor Barry Noller entitled *Moolarben Coal Independent Water Quality Study (IWQS)* and dated 10 December 2021. The EPA requested DPE Science, Economics and Insights assist in the review of the IWQS report.

The Upper Goulburn River

The Goulburn River is the key drainage line in the Ulan region, running from the west of the Moolarben Coal Complex (MCC) to the northeast, including through the Goulburn River Diversion (developed by Ulan Coal in the 1980s). The Goulburn River receives tributary inputs from Moolarben Creek (which includes Ryans Creek and Lagoon Creek), Sportsmans Hollow Creek and Ulan Creek, as well as licensed discharges from MCO (directly into Goulburn River Diversion) and Ulan Coal (via Ulan Creek; Figure 1).

There are a variety of potential sources of salinity in the Hunter River catchment[3] including rainfall, atmospheric deposition, run-off and infiltration, weathering of geological strata, groundwater and a range of anthropogenic sources including the Hunter River Salinity Trading Scheme (HSTS; see EPA 2013). The Goulburn River sub-catchment can contribute relatively high salinity water to the Hunter River, but it is not currently captured by the Scheme upstream of Kerrabee. Due primarily to its location with the upper reaches of the Goulburn River Catchment, UCML were not afforded the regulatory provisions detailed within the Hunter River Salinity Trading Scheme for the management of saline water generated through its industrial processes (UCML 2006). The same situation applies to Moolarben Coal. Having large volume discharges located high in the catchments of rivers will always be problematic due to low flows and the lack of dilution that can practically be achieved for such discharges. Alternative management action needs to take place if the salt levels/loads from such discharges are not to have adverse impacts on the receiving environment and downstream users.

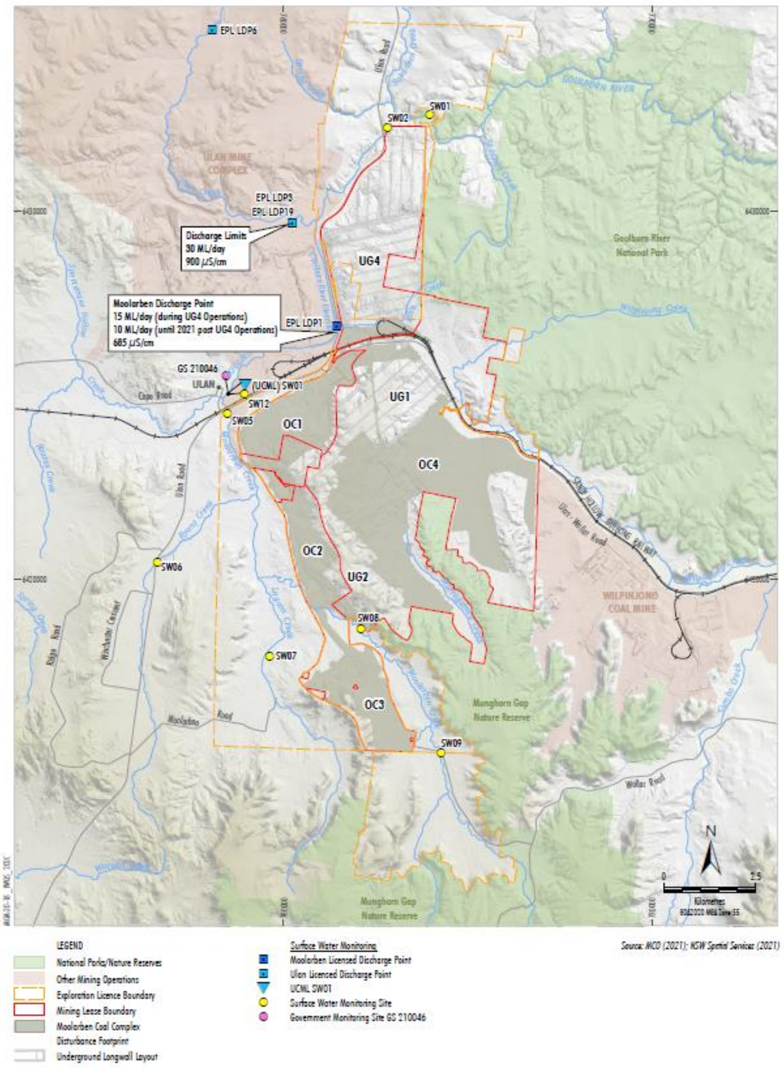

Figure 1. Major streams and monitoring sites in the Upper Goulburn River. Source: Noller 2022.

The increasing salinisation of Australia's freshwater streams and rivers is also of increasing concern. Scientific experts in this area (e.g., Cañedo-Argüelles et al 2016) have recently argued that salinity standards for specific ions and ion mixtures, not just for total salinity, should also be developed and legally enforced to protect freshwater life and ecosystem services.

Upper Goulburn River Flow

The primary tributary of the Upper Goulburn River is Moolarben Creek which flows north alongside the western boundary of the Moolarben Coal Complex (MCC). Moolarben Creek meets Sportsmans Hollow Creek at Ulan Village (Figure 1). The intersection of these two tributaries forms the headwaters of the Goulburn River. Wilpinjong Creek drains in a south-easterly direction along the eastern boundary of the Moolarben Coal Complex and joins Wollar Creek, before joining the Goulburn River approximately 26 km downstream of the Moolarben Coal Complex.

The Moolarben Creek Dam is located on Moolarben Creek, approximately 1.5 km upstream of the confluence with Sportsmans Hollow Creek. It was constructed between 1955 and 1957 to supply cooling water for the Ulan Power Station. Ulan Power Station was decommissioned in 1968. The Moolarben Creek Dam is located on land owned by the UCML and has a storage volume of approximately 170 ML. UCML has a licence (WAL19047) to extract up to 600 ML per year of water from Moolarben Creek Dam. Environmental flows are released from the dam in accordance with the licence conditions for this structure. Water licence works approval 20WA209953 requires that: '*Flow of not less than 7 L/sec*[8] *pass out of the Moolarben Dam into Moolarben Creek downstream of the dam at all times, provided that when the flow into the stored water is less than 7 L/sec, the flow to be passed out of the dam wall shall be that flowing into the stored water for the time being*'. [Advisian 2017 Moolarben Coal Complex Open Cut Optimisation Modification APPENDIX F Controlled Water Release Impact Assessment October 2017 Assignment No 26513 www.advisian.com]. There is no public disclosure of daily environmental flow releases from Moolarben Dam. The quality of water within Moolarben Dam is also not publicly reported.

The EPA licences Moolarben Coal (MCO) via EPL 12932. MCO has three existing licenced discharge points under EPL 12932, namely:

- EPL ID1 – to Bora Creek from Cockies Dam;
- EPL ID2 – to Goulburn River from Open Cut 1 (OC1) Sediment Dam 6;
- EPL ID28 – to Moolarben Creek from OC2 Dam.

In addition, Ulan Coal (UCML) has two licenced discharges (LDP6 & LDP19) to Ulan Creek, which flows to the Upper Goulburn River downstream of Bora Creek.

Flow exceedance curves were calculated for each of the gauging stations (SW01, SW02) and Licensed Discharge Points (UCML LDP6 & 19; MCO LDP1) that had available data (see Figure 2).

Relevant observations are:

- Median flow for the Water Resources Gauge (210046) over the period 10/3/1956 to 31/8/1982 was 2.225 ML/day
- The long-term median flow reported at SW01 over the last decade was 0.183 ML/day (maximum 904.5 ML/day[9])
- The long-term median discharge (since 18/5/2020) from MCO LDP1 is 8.7 ML/day[10] (maximum 10.7 ML/day)
- The long-term median discharge from UCML LDP6 is 5.3 ML/day[11] (maximum 15.75 ML/day)

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[8] This equates to approximately 0.6 ML/day which is much higher than the median flow recorded at SW01.

[9] This maximum flow (over 370 Olympic Swimming pools in volume) was recorded to have occurred on 8th December 2021. Rainfall records for the BoM Ulan rainfall gauge suggested only around 24mm rain fell on this date, so the source of this very high-volume discharge needs further investigation.

[10] Approximately 3.6 Olympic Swimming Pools per day and 47 times the median flow recorded at SW01.

[11] Approximately 2 Olympic Swimming Pools per day and 29 times the median flow recorded at SW01.

- The long-term median discharge from UCML LDP19 is 7.1 ML/day[12] (maximum 21.03 ML/day)
- The combined long term median discharge from UCML LDP19 & LDP6 is 11.2 ML/day[13] (maximum 30.19 ML/day)
- The long-term median flow at SW02 is 15.4 ML/day (maximum 2032 ML/day)

The overwhelming majority of the flow in the Upper Goulburn River is mine discharge waters, significantly exceeding natural flows by orders of magnitude. All this mine water subsequently flows downstream and into Goulburn River National Park.

The IWQS appears to have relied on only one sample (taken 24 June 2021[14]) for toxicity testing. If information on the Upper Goulburn River on the date the sample was taken is analysed in detail:

- Rainfall at the BoM Ulan rainfall gauge was 1mm on 24 June 2021
- Flow at SW01 was recorded to be 10.4 ML/day on 24 June 2021
- Discharge from MCO LDP1 was recorded as 7.8 ML/day on 24 June 2021
- Combined Discharge from UCML LDP6 & LDP19 was recorded as 22 ML/day on 24 June 2021
- Flow at SW02 was recorded to be 63.6 ML/day on 24 June 2021.

This leaves a difference in flow between SW01 and SW02 of 53.2 ML/day. After allowing for cumulative mine discharges on this day (29.8 ML/day), this leaves 23 ML/day[15] of flow unaccounted for. The two major streams in the area that join the Goulburn River in between SW01 & SW02 (Ulan Ck and Bora Ck) would collectively have to be discharging twice the amount of water measured at SW01 to explain this difference. This suggests that either significant (unmeasured flows) are coming from tributaries in-between SW01 and SW02, or there are considerable inaccuracies in the flow ratings curves and flow measurements for SW01 & SW02. This issue needs further detailed investigation.

[12] Approximately 3 Olympic Swimming Pools per day and 39 times the median flow recorded at SW01.

[13] Approximately 4.7 Olympic Swimming Pools per day and 61 times the median flow recorded at SW01.

[14] *Diluent water for control in the ecotoxicity testing was selected for collection from the Goulburn River reference monitoring site UCML SW01 / SW12 (2x25 L: Figure 4) above the mine influence, and WTP Filtrate (1x25 L) as the treatment water at MCO for EC and salinity toxicity evaluation were collected in 5 L acid-rinsed containers on 24 June 2021*. [IWQS p34]

[15] Approximately 10 Olympic swimming pools.

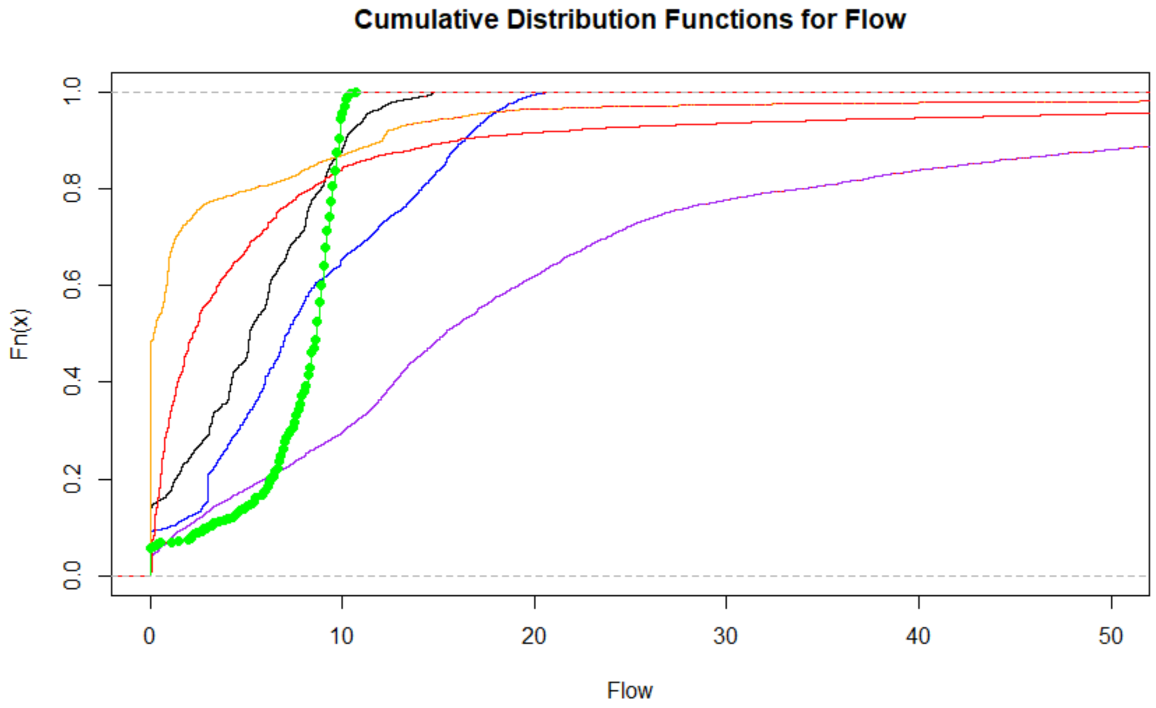

Figure 2. Flow/discharge exceedance curves for the Upper Goulburn River. MCO LDP1=green; UCML SW01=orange; UCML SW02=purple; DLWC 210046=red; UCML LDP6=black; UCML LDP19=blue. Note the difference between flow exceedance curves for the upstream discharge site SW01, the downstream discharge site SW02, the UCML discharges from LDP6 & LDP19 and the MCO discharge LDP1. Data Sources: Moolarben Coal, UCML and NSW Government Pineena Database.

Conclusions

The overwhelming majority of the current flow in the Upper Goulburn River is mine discharge waters, significantly exceeding natural flows by orders of magnitude. All this mine water subsequently flows downstream and into the Goulburn River National Park.

The IWQS appears to have relied on only one sample (taken 24 June 2021[16]) for toxicity testing. Extrapolating toxicity assessments from one sample to all samples is considered dangerous given the likely variability in mine effluent on any given day.

There are significant discrepancies in the flow records at times, including unexplained flow additions in between SW01 (upstream of discharge locations) and SW02 (downstream of discharge locations).

Further flow monitoring in unmonitored streams (i.e., Ulan Ck upstream of UCML discharges; Bora Creek upstream of MCO discharges; Sportsman Hollow Creek) is required to resolve whether there are quality assurance/quality control issues with existing gauges (at SW01 and SW02). The accuracy of discharge flow measurements (at MCO LDP1, and UCML LDP6 & LDP19) also warrant further investigation.

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[16] *Diluent water for control in the ecotoxicity testing was selected for collection from the Goulburn River reference monitoring site UCML SW01 / SW12 (2x25 L: Figure 4) above the mine influence, and WTP Filtrate (1x25 L) as the treatment water at MCO for EC and salinity toxicity evaluation were collected in 5 L acid-rinsed containers on 24 June 2021*. [IWQS p34]

Daily measurement of inflows to and releases from Moolarben Dam are needed to provide a context for the flows at SW01. It is noted that at least one Discharge location (EPL ID28 – to Moolarben Creek from OC2 Dam) for Moolarben Coal appears to be to Moolarben Creek upstream of Moolarben Dam. Limited information was available on any discharges from EPL ID28.

Upper Goulburn River Electrical Conductivity Levels

Electrical Conductivity (EC) levels recorded in the Upper Goulburn River over the last decade are illustrated in Figures 3. Where UCML and MCO recorded EC levels on the same day they are compared in Figure 4. EC concentration exceedance curves were additionally calculated for each of the gauging stations (SW01, SW02) and Licensed Discharge Points (UCML LDP6 & 19; MCO LDP1) that had available data (see Figure 5). Relevant observations are:

- EC levels in the Upper Goulburn River are affected by drought and by upstream flows during rain events;
- There are discrepancies in measured EC levels at UCML site SW01 and MCO sites UCMLSW01 & SW12 on the same day;
- The IWQS background calculations are primarily based on results for SW12 with MCO UCML SW01[17] results restricted to the 2016/2017 period;
- Over the period 1968-1982 (n=50) the median conductivity recorded for Station 210046 was 432 µS/cm and the 80$_{th}$ percentile was 580 µS/cm;
- The long-term median EC level at SW01 is 517 µS/cm (UCML Annual Reports; maximum 3389 µS/cm[18]);
- The long-term median EC level (since 18/5/2020) from MCO LDP1 is 258 µS/cm[19] (maximum 349 µS/cm);
- The long-term median EC level from UCML LDP6 is 787 µS/cm[20] (UCML Annual Reports; maximum 1284 µS/cm);
- The long-term median EC level from UCML LDP19 is 787 µS/cm[21] (UCML Annual Reports; maximum 1070 µS/cm); and
- The long-term median EC level at SW02 is 769 µS/cm[22] (UCML Annual Reports; maximum 2442 µS/cm).

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[17] Care needs to be exercised with site nomenclature so that the *UCML SW01* site is not confused with the *MCO SW01* site, the latter located downstream of the *UCML SW02* site.
[18] This maximum EC level was recorded on 10th February 2020 towards the end of the 2019/20 drought and is likely a direct response to that drought. It is unclear whether there was flow in the creek at this time.
[19] Approximately half the median EC level recorded at SW01.
[20] Approximately 1.5 times the median EC recorded at SW01.
[21] Approximately 1.5 times the median EC recorded at SW01.
[22] Approximately 1.5 times the median EC recorded at SW01.

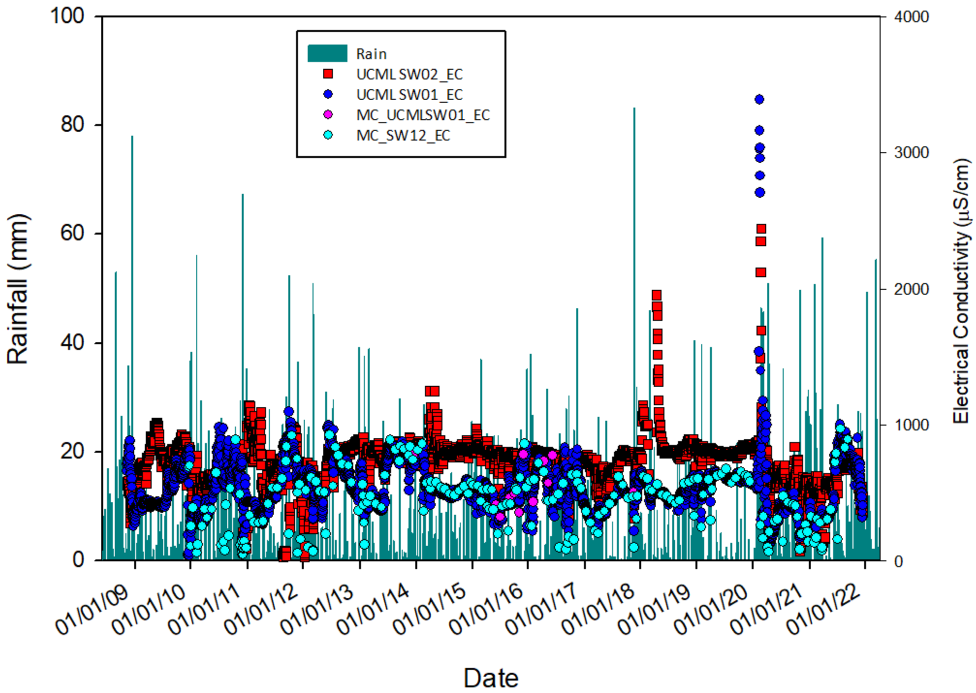

Figure 3. Conductivity levels in the Upper Goulburn River. Data Sources: Moolarben Coal and UCML.

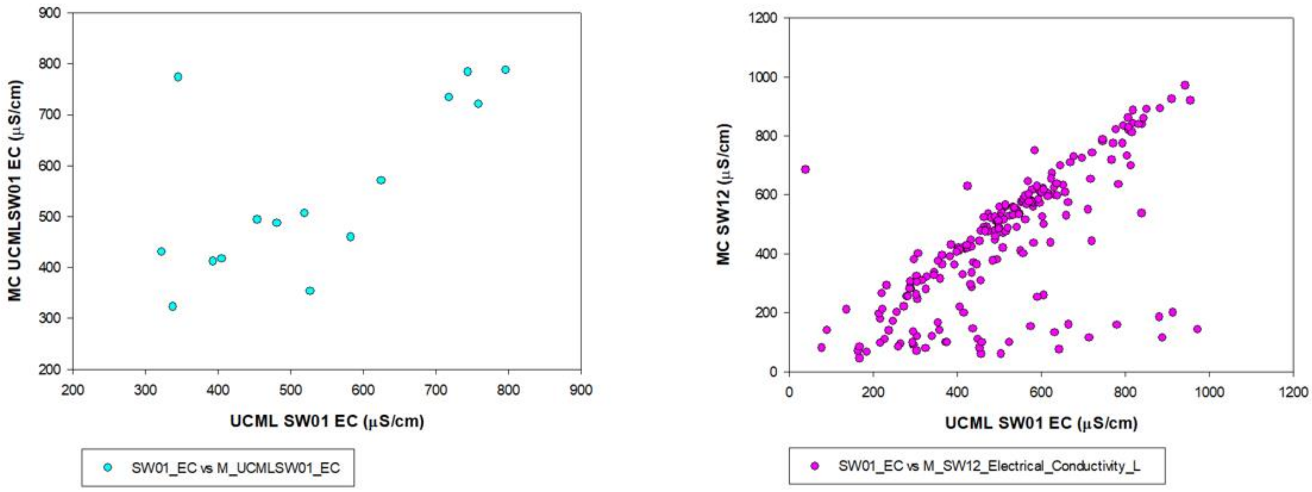

Figure 4. Discrepancies in Conductivity levels measured on the same day in the Upper Goulburn River. Data Sources: Moolarben Coal (M_SW12 & M_UCMLSW01) and UCML (SW01).

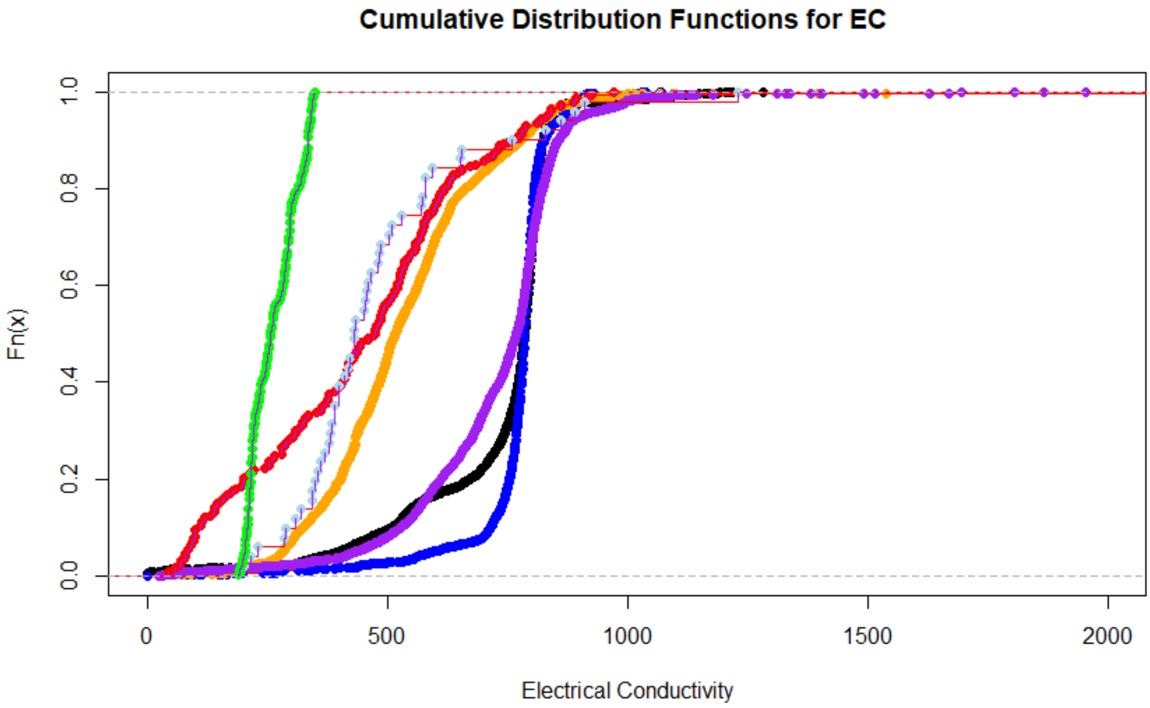

Figure 5. Concentration exceedance curves for electrical conductivity (µS/cm) in the Upper Goulburn River. MCO LDP1=green; MCO IWQS EC=red; UCML SW01=orange; UCML SW02=purple; DLWC 210046=light blue; UCML LDP6=black; UCML LDP19=blue. Note the difference between EC exceedance curves for the upstream discharge site SW01, the downstream discharge site SW02 and the UCML discharges from LDP6 & LDP19. Data Sources: Moolarben Coal and UCML

Conclusions

The IWQS did not consider all Electrical Conductivity (EC) data that exists for UCML site SW01[23].

The dataset used for EC calculations did not include any of the earlier data for GS210046[24]. If the earlier GS210046 data are added to the EC data used to generate an 80th percentile EC level in the IWQS, then using the ANZECC approach the result would be an EC level of **616 µS/cm[25]**.

The IWQS did not identify or discuss the discrepancies between Moolarben Coal's and UCML's EC levels measured in the Upper Goulburn River on the same day for sites in close proximity (UCML SW01 and SW12)[26].

The IWQS did not identify whether the Goulburn River was flowing (or ponded) at the time of water quality sampling for the data used in the water quality assessment.

Since the MCO LDP1 discharge is currently achieving EC levels of 250 µS/cm to 350 µS/cm for LDP1, there appears to be little need to have a higher EC level than this on the EPL. Having a higher EPL

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[23] In particular, the publicly available data in UCML's Annual Reports for the last decade.

[24] EPA's letter, included with the IWQS, stated: *The EPA has reviewed the supplementary information contained within your letter and agrees that the proposed use of monitoring data from 'UCML SW01 and other co-located sites (namely **SW12 and GS 210046**)' is appropriate to be used in the IWQS to determine background salinity.*

[25] ~70 µS/cm lower than that calculated in the IWQS.

[26] Or the reasons for such discrepancies.

limit could potentially provide an incentive to increase salt load discharges to the Upper Goulburn River even further.

The IWQS has taken a very narrow focus on just EC and salinity and has failed to consider the ionic composition of the proposed discharge waters. The increasing salinisation of Australia's freshwater streams and rivers is of significant concern. Scientific experts in this area (e.g., Cañedo-Argüelles et al 2016) have also recently argued that salinity standards for specific ions and ion mixtures, not just for total salinity, should also be developed and legally enforced to protect freshwater life and ecosystem services.

The IWQS has provided limited data on the ionic composition of discharge waters or natural waters in the Upper Goulburn River. The IWQS has not considered the effects of individual ionic constituents in the discharge on the receiving environment.

The IWQS appears to have relied on only one sample (taken 24 June 2021[27]) for toxicity testing. Extrapolating toxicity assessments from one sample to all discharges is considered dangerous given the likely variability in mine effluent on any given day.

Replicate toxicity sampling of all discharges on multiple days is needed to better understand the effects of mine discharges on the aquatic communities of the Upper Goulburn River.

Upper Goulburn River Salt Load

Whilst the previous section discussed salt concentrations, the cumulative salt load being added into the Upper Goulburn River also needs consideration. Salt loads based on median and average EC concentrations and flows/discharge rates are included in Table 1.

	LDP6	LDP19	LDP6 & LDP19	SW01	SW02	LDP1	
Median Loads							
	954.1	1303.6	2257.8	734.3	2758.2	457.9	t/year
Average Loads							
	905.8	1839.1	2744.9	661.0	4750.0	468.6	t/year

Table 1. Salt loads to the Upper Goulburn River. Median and average EC levels have been converted to Total Dissolved Solids using a factor of 0.64 and then multiplied by flow/discharge level to estimate annual salt loads.

Using the information provided in Table 1:

- The background salt load to the Upper Goulburn River based on SW01 data is between 600 and 735 tonnes/annum[28]
- MCO LDP1 adds an additional 457 to 469 tonnes/annum of salt to the Upper Goulburn River system

[27] *Diluent water for control in the ecotoxicity testing was selected for collection from the Goulburn River reference monitoring site UCML SW01 / SW12 (2x25 L: Figure 4) above the mine influence, and WTP Filtrate (1x25 L) as the treatment water at MCO for EC and salinity toxicity evaluation were collected in 5 L acid-rinsed containers on 24 June 2021*. [IWQS p34]

[28] Such loads were estimated to be much lower (~220 tonnes/annum) using the NSW Government gauge/water quality data for Stn210046. This may imply that major changes to natural salt loadings to the Upper Goulburn River have occurred at SW01 over the last 2 decades.

- UCML LDP6 and LDP19 collectively add between 2257 and 2745 tonnes/annum of salt to the Upper Goulburn River system
- The salt load at SW02 (2758 to 4750 tonnes/annum) is 3.5-7 times more than what is naturally in this system[29].

Conclusion

The IWQS has not considered the cumulative effects of salt loads on the receiving environment or their effect on downstream areas, including Goulburn River National Park.

Upper Goulburn River pH Levels

The last decade or more of pH levels recorded in the Upper Goulburn River are illustrated in Figure 6. pH concentration exceedance curves were additionally calculated for each of the gauging stations (SW01, SW02) and Licensed Discharge Points (UCML LDP6 & 19; MCO LDP1) that had available data (see Figure 7). Relevant observations are:

- pH levels in the Upper Goulburn River are also affected by drought and by upstream flows during rain events;
- pH levels recorded at SW12 were often much higher than those recorded at SW01[30];
- The long-term median pH level at SW01 is 6.96 (UCML Annual Reports; maximum 8.99);
- The long-term median pH level (since 18/5/2020) from MCO LDP1 is 7 (maximum 7.3);
- The long-term median EC level from UCML LDP6 is 7.6 (UCML Annual Reports; maximum 8.76);
- The long-term median EC level from UCML LDP19 is 7.17 µS/cm[31] (UCML Annual Reports; maximum 9.09); and
- The long-term median EC level at SW02 is 7.73 (UCML Annual Reports; maximum 8.91).

[29] Based on estimated salt loads at SW01.
[30] In some cases, even higher than those recorded downstream of the discharges at SW02
[31] Approximately 1.5 times the median EC recorded at SW01.

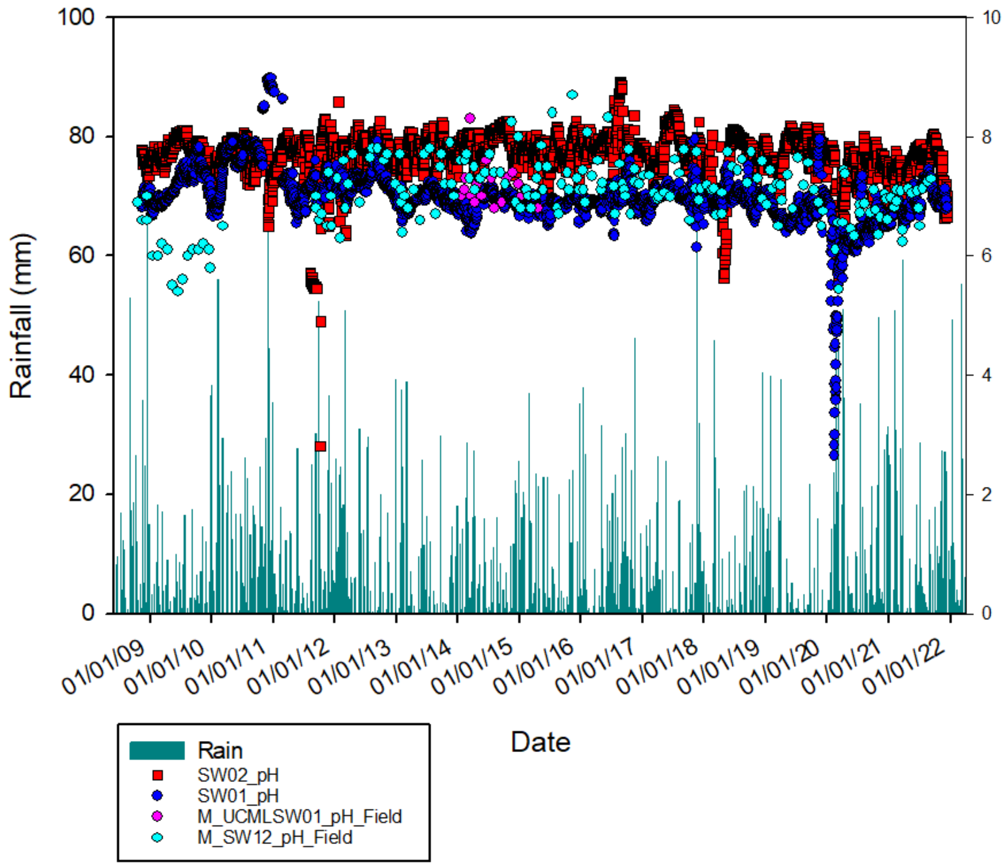

Figure 6. pH levels in the Upper Goulburn River. Data Sources: Moolarben Coal and UCML.

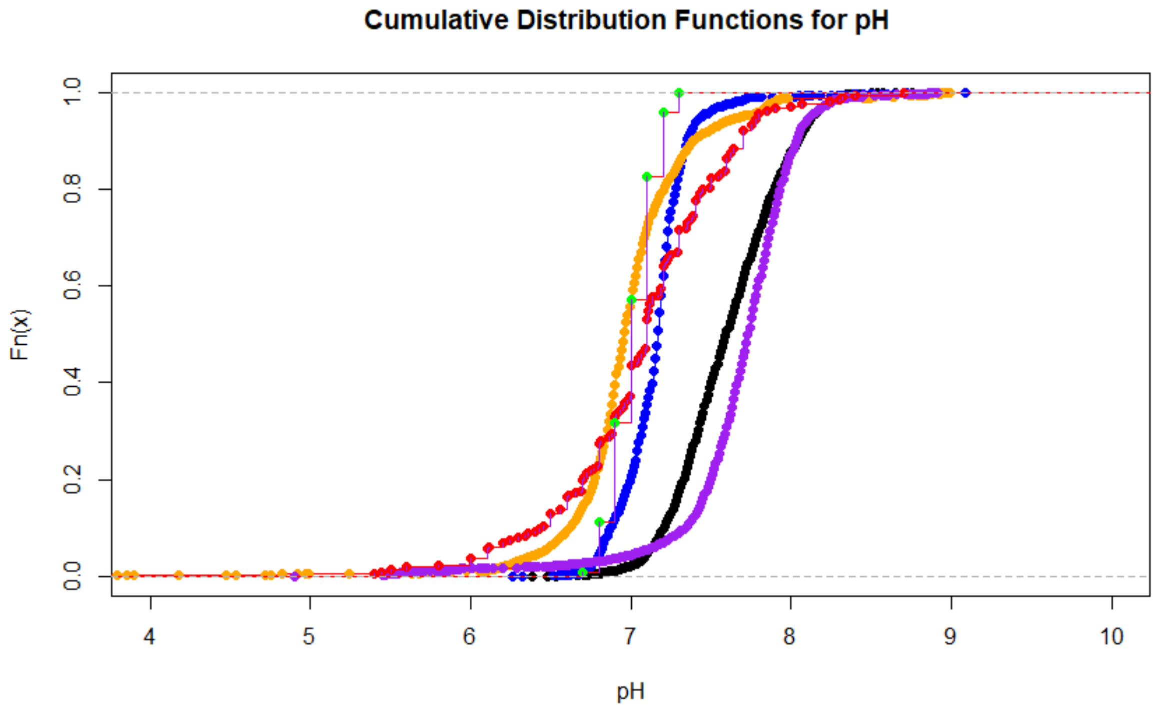

Figure 7. Concentration exceedance curves for pH in the Upper Goulburn River. MCO LDP1=green; MCO IWQS EC=red; UCML SW01=orange; UCML SW02=purple; UCML LDP6=black; UCML LDP19=blue. Note the

difference between pH exceedance curves for the upstream site SW01, the downstream discharge site SW02 and the UCML discharges from LDP6 & LDP19.

Conclusion

The discharges into the Upper Goulburn River significantly alter the pH of the waters[32] making them much more alkaline than that measured at the upstream SW01 site.

References

Advisian 2017 Moolarben Coal Complex Open Cut Optimisation Modification APPENDIX F Controlled Water Release Impact Assessment October 2017 Assignment No 26513 www.advisian.com

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Martin Krogh
Principal Scientist Major Assessments
Science, Economics and Insights Division
Department of Planning and Environment

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[32] Since pH is measured on a log-scale, the magnitude of difference is much higher than the absolute difference would indicate. This turns a near neutral pH stream into a much more alkaline system.